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Managing Stochastic Demand in an Inventory Routing Problem with Transportation Procurement

Luca Bertazzi[*] Adamo Bosco[†] Demetrio Laganà[‡]

Abstract

We study an Inventory Routing Problem in which the supplier has a limited production capacity and the stochastic demand of the retailers is satisfied with procurement of transportation services. The aim is to minimize the total expected cost over a planning horizon, given by the sum of the inventory cost at the supplier, the inventory cost at the retailers, the penalty cost for stock–out at the retailers and the transportation cost. First, we show that a policy based just on the average demand can have a total expected cost infinitely worse than the one obtained by taking into account the overall probability distribution of the demand in the decision process. Therefore, we introduce a stochastic dynamic programming formulation of the problem that allows us to find an optimal policy in small size instances. Finally, we design and implement a matheuristic approach, integrating a rollout algorithm and an optimal solution of mixed–integer linear programming models, which is able to solve realistic size problem instances. Computational results allow us to provide managerial insights concerning the management of stochastic demand.

Keywords: Inventory Routing Problem, Stochastic Demand, Transportation Procurement, Dynamic Programming, Matheuristic.

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